# SAWL-High Intensity Solar Light

## Programming, Configuration and Installation

User's Manual

96A0444

66962 Rev A

**Retain for future use.**

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ADB

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# 1.0 Safety

This section contains general safety instructions for installing and using ADB Airfield Solutions equipment. Some safety instructions may not apply to the equipment in this manual. Task- and equipment-specific warnings are included in other sections of this manual where appropriate.

## 1.1 To use this equipment safely:

**WARNING**

Read installation instructions in their entirety before starting installation.

- Refer to the FAA Advisory Circular AC 150/5340-26, Maintenance of Airport Visual Aids Facilities, for instructions on safety precautions.
- Observe all safety regulations. To avoid injuries, always disconnect power before making any wiring connections or touching any parts. Refer to FAA Advisory Circular AC 150/5340-26.
- Become familiar with the general safety instructions in this section of the manual before installing, operating, maintaining or repairing this equipment.
- Read and carefully follow the instructions throughout this manual for performing specific tasks and working with specific equipment.
- Make this manual available to personnel installing, operating, maintaining or repairing this equipment.
- Follow all applicable safety procedures required by your company, industry standards and government or other regulatory agencies.
- Install all electrical connections to local code.
- Use only electrical wire of sufficient gauge and insulation to handle the rated current demand. All wiring must meet local codes.
- Route electrical wiring along a protected path. Make sure they will not be damaged by moving equipment.
- Protect components from damage, wear, and harsh environment conditions.
- Allow ample room for maintenance, panel accessibility, and cover removal.
- Protect components from damage, wear, and harsh environment conditions.
- Allow ample room for maintenance, panel accessibility, and cover removal.
- Protect equipment with safety devices as specified by applicable safety regulations.
- If safety devices must be removed for installation, install them immediately after the work is completed and check them for proper functioning prior to returning power to the circuit.



### 1.1.1 Additional Reference Materials:

- NFPA 70B, Electrical Equipment Maintenance.
- NFPA 70E, Electrical Safety Requirements for Employee Workplaces.
- ANSI/NFPA 79, Electrical Standards for Metalworking Machine Tools.
- OSHA 29 CFR, Part 1910, Occupational Health and Safety Standards.
- National and local electrical codes and standards.

### 1.1.2 Safety & Usage

The following symbols indicate important safety warnings and precautions throughout this manual:

WARNING indicates that serious bodily harm or death may result from failure to adhere to the precautions.

CAUTION indicates that damage to equipment may result if the instructions are not followed.

NOTE suggests optimal conditions and provides additional information.

WIRELESS features and functions that require a Handheld Controller.

### 1.1.3 Viewing Precautions

Do not view an actively emitting infrared or visible light from the side of the light (close to or on beam) from a range of less than 4 ft. (1.2 m).

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A safe limit for near-infrared viewing, established by the American Conference of Governmental and Industrial Hygienists (ACGIH), is 65 mW/in$^2$ (10 mW/cm$^2$) as the maximum exposure limit for viewing for up to 16 minutes. This power density can be produced at the lens surface when actively emitting infrared light.

### 1.1.4 Battery Precautions

Use extreme caution when handling the light. This product is capable of generating enormous short-circuit currents. Remove all jewelry (bracelets, metal-strap watches, rings) before attempting to handle or remove the batteries.

Charge your battery periodically. Permanent damage and reduced capacity will result if the battery is not correctly maintained.

The rate of battery self-discharge is very dependent upon temperature. The warmer the temperature, the faster the batteries will discharge.

Lights that have been stored will usually require a top-up charge before they are put into service. The most accurate battery health status reading is obtained when the unit has been in a dark location and in off mode for at least 24 hours.

### 1.1.5 Wireless Precautions

Keep the Handheld Controller at a distance of at least 3 ft. (1 m) from the antennas of lights or other Handheld Controllers. It sends out a powerful radio signal that could damage sensitive receiver circuitry if operated at close range.

Regulatory

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications; however, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off or on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna;
- Increase the separation between the equipment and receiver;
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected;
- Consult the dealer or an experienced radio/TV technician for help.

This Class [B] digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe [B] est conforme à la norme NMB-003 du Canada.

### 1.1.6 Warranty Disclaimer

This manual will familiarize you with the features and operating standards of the product. Failure to comply with the use, storage, maintenance, or installation instructions detailed in this manual could void the user warranty.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. Installation work must be done by a qualified person(s) in accordance with all application local codes and standards.


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# 2.0 SAWL-Hi

SAWL-High Intensity (SAWL-Hi) Programming, Configuration and Installation.

## 2.1 About this manual

The manual shows the information necessary to:

- Program and Configure SAWL-High Intensity Lights.

### 2.1.1 How to work with the manual

1. Become familiar with the structure and content.
2. Carry out the actions completely and in the given sequence.

### 2.1.2 Record of changes

| Page | Rev | Description | Checked | Approved | Date |
|---|---|---|---|---|---|
| All | A | Released Manual | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

### 2.1.3 Icons used in the manual

For all WARNING symbols see the Safety section.

Carefully read and observe all safety instructions in this manual, which alert you to safety hazards and conditions that may result in personal injury, death or property and equipment damage and are accompanied by the symbol shown below.

**WARNING**

- Failure to observe a warning may result in personal injury, death or equipment damage.

**CAUTION**

- Failure to observe a caution may result in equipment damage.



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## 2.2 Introduction

This section describes the SAWL High Intensity fixture.

### 2.2.1 FCC Compliance

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by ADB Airfield Solutions, LLC could void your authority to operate the equipment.

**FCC Statement for Solar Aviation Wireless Light (SAWL) Light and Wireless Controller**

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications; however, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off or on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

**FCC Statement for Non-wireless Solar Aviation Wireless Light (SAWL) Light**

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case you will be required to correct the interference at your own expense.

### 2.2.2 Solar Aviation Wireless Light

2.2.2.1 Compliance with Standards

Solar LED Aviation and Obstruction Lights are certified to:

CE, RoHS, ICAO, Explosive Atmosphere MILSTD-810G, Method 511.3

2.2.2.2 Uses

The SAWL High Intensity solar LED aviation light – designed for on-command performance in extreme conditions – features an innovative combination of solar power, LEDs, and an optional secure wireless control system. The control system allows for on-command operation from ground or air over a range of up to 2.48 miles (4 km). Applications include: Runway edge lighting – (ICAO Annex 14); portable or expedited airfield lighting; emergency runway lighting; helipad lighting; and threshold lighting.




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2.2.2.3 Features

- Easy installation and relocation: no specialized work crew required, limited air traffic disruption, and lights are immediately operational. Featuring a built-in handle, the SAWL can be quickly relocated for temporary or emergency applications. Multiple mounting options allow for three or four-bolt mounting patterns.
- Self-contained and low maintenance: all components are incorporated within a compact, stand-alone unit. The SAWL also features a replaceable battery pack that extends the service life beyond five years, reducing the total cost of ownership and resulting in significant cost savings.
- Unprecedented reliability: microprocessor Energy Management System (EMS) monitors and adapts the brightness to environmental conditions for consistent operation and long life under the toughest conditions.
- User friendly: easy programming and operation options include push-button operation or optional wireless control system offering secure 900 MHz wireless control from ground or air. External 12 V service port allows for external charging or use of supplementary power source.
- Protect personnel and assets: Optional handheld wireless control allows for remote operation of a SAWL airfield including mode changes for enhanced visibility in poor weather conditions, or to blackout or infrared in response to immediate threat.
- Meets tough industry standards: Certifications include ICAO and Explosive Atmosphere. (**NOTE**: more detailed info to come).
- Green solution: a clean, renewable and reliable energy source with the lightest environmental footprint. The SAWL features recyclable batteries.
- Six intensity level settings.
- Dusk-to-dawn or on-command operation.
- Programming options include push-button operation or optional wireless control system.
- NVG-compatible IR option available with all color combinations.

**Table 1: Equipment Data**

| | |
|---|---|
| Solar Panel | High-efficiency solar panels |
| Battery | Replaceable, recyclable best-in-class battery pack with extreme temperature range. Battery status feedback via LEDs |
| Light Source | Ultra-bright LEDs feature innovative optic and lens design for optimum light divergence. |
| Intensity | 44.3 cd autonomous high mode. See photometric plot. |
| Flash Patterns | Steady-on only. User-programmed via onboard push-button switch or optional handheld wireless controller. |
| Construction | Fully self-contained weather, corrosion and vandal-resistant unit with premium-grade UV-resistant polycarbonate head. |
| Colors | LEDs: white, red, amber, blue, red/green split, amber/white split, red/white split. All colors available with infrared CHASSIS: aviation yellow, olive drab |
| Ambient Operating Temp. | -22 to 122° F (-30 to 50° C) |
| Storage Temperature | -40 to 176° F (-40 to 80° C) |
| Weight | 26 lb (11.75 kg) |
| Automatic Light Control (ALC) | ALC dynamically reduces brightness in response to unusually low amounts of sunlight to ensure continued operation |
| Radio Receiver | 902-928 MHz FHSS |
| External Service Port | 12V DC |



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### 2.2.3 Wireless Hand-Held Controller

One or more wireless SAWL-Hi lights can be remotely operated from the ground or air with a handheld wireless controller: secure radio transceiver, with antenna and keypad.

**Wireless Hand-Held Controller**
**Ordering Code** **Part # SAWL-HC**

Battery Replacement Kit for
Wireless Hand-held Controller ———— Part # 48247

### 2.2.4 Features

- Water-resistant keypad and LED indicators.
- Utilizes a secure wireless RF signal.
- Control range of up to 2.5 miles.
- Meets MIL-SPEC-810E environmental requirements.
- 24-hour operation on a single charge.
- Rechargeable lithium-ion battery (included); recharges via an AC/DC wall plug (included).
- Compatible with stand-alone aviation band VHF receiver.
- Comes complete in a custom Pelican™ case.

### 2.2.5 Spare Components

For a complete list of solar aviation light accessories, including mounting equipment, see Catalog Sheet 3017.




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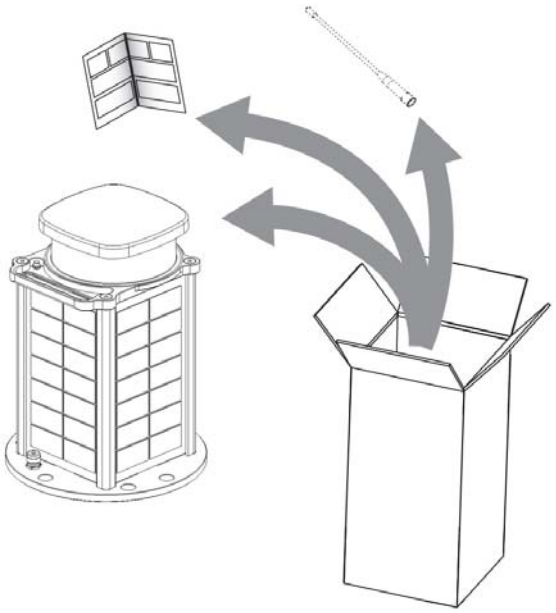
## 2.3 Installation

The SAWL-Hi includes:

- SAWL-Hi
- Antenna (Wireless Only)
- Quick Start Guide



The manual (this document) is shipped independently. It is available for download from www.adb-airfield.com



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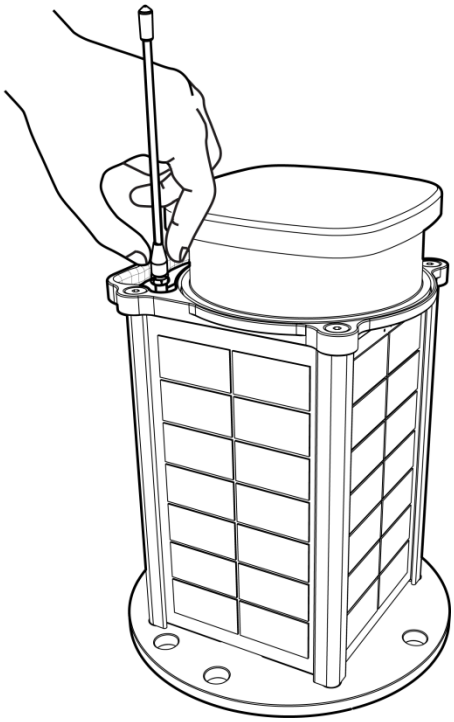
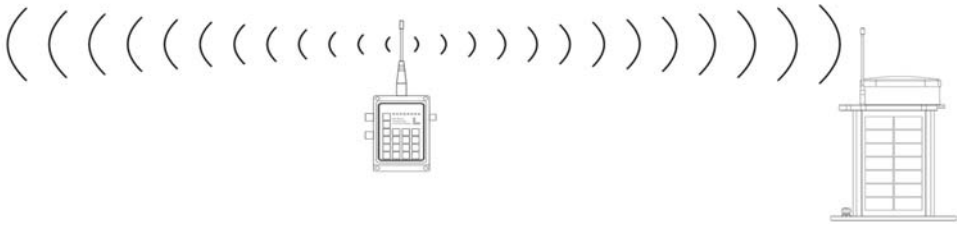
### 2.3.1 Antenna

Only the SAWL-Hi with optional wireless control includes an antenna. Grip the antenna by its metal base and hand-tighten it onto the antenna connector.



The effective range of the wireless control system is 2.5 miles (4 km). Wireless range is greatly affected by use and location. To achieve the best wireless range:

— Handheld Controller antenna is parallel to the light's antenna



— Elevate the Handheld Controller's antenna
— Ensure surrounding grass and foliage is trim
— Clear line-of-sight between antennas

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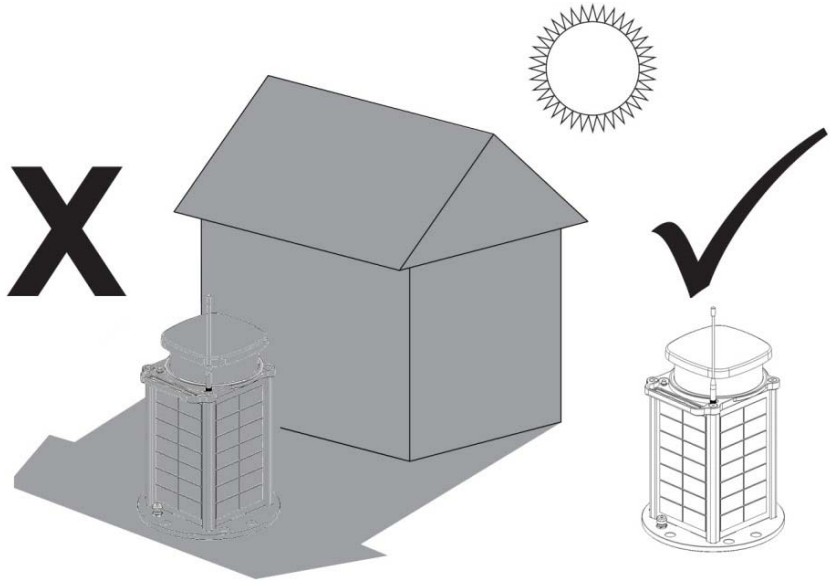
### 2.3.2 Location

Year-round, unrestricted solar exposure is critical to long-term performance.

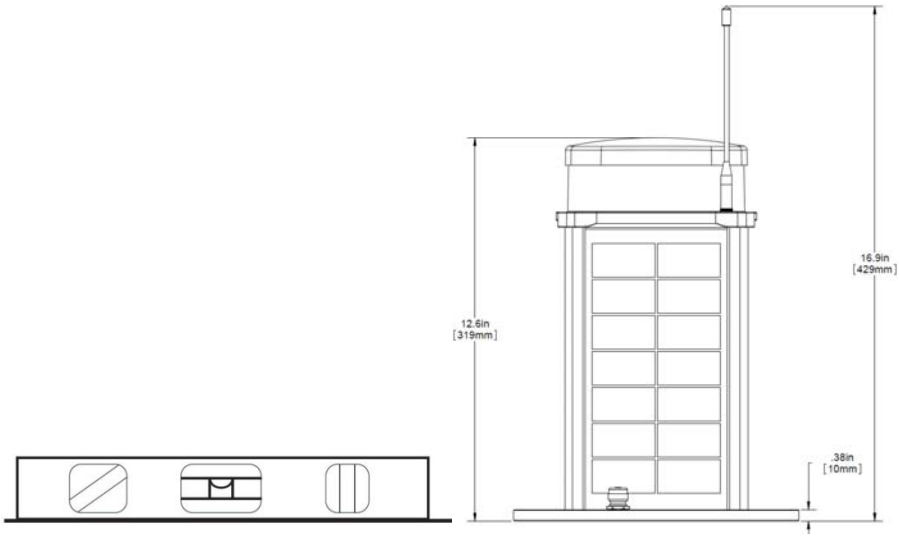
Shade dramatically reduces the ability of the light to charge its battery.

**Year-round sun:** During the winter, the sun is lower on the horizon. Because the angle of the sun changes with the seasons, you must be aware that obstructions such as trees, buildings, and mountains that do not shade the solar panel during the summer may shade it during the winter.



**Cooler is better:** The battery lasts longest if you can minimize its exposure to high temperatures. Choose a location that is away from hot, dark colored surfaces like asphalt or black steel plate. Mounting kits are available that elevate the light and can help reduce the temperature of the battery.

**Flat:** Ensure the mounting surface is flat and level. .



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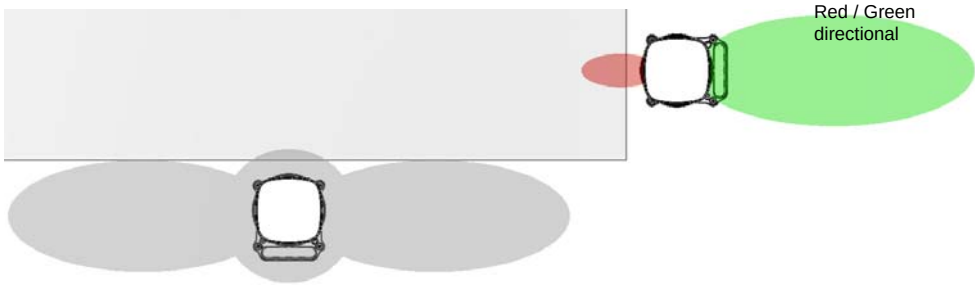
### 2.3.3 Orientation

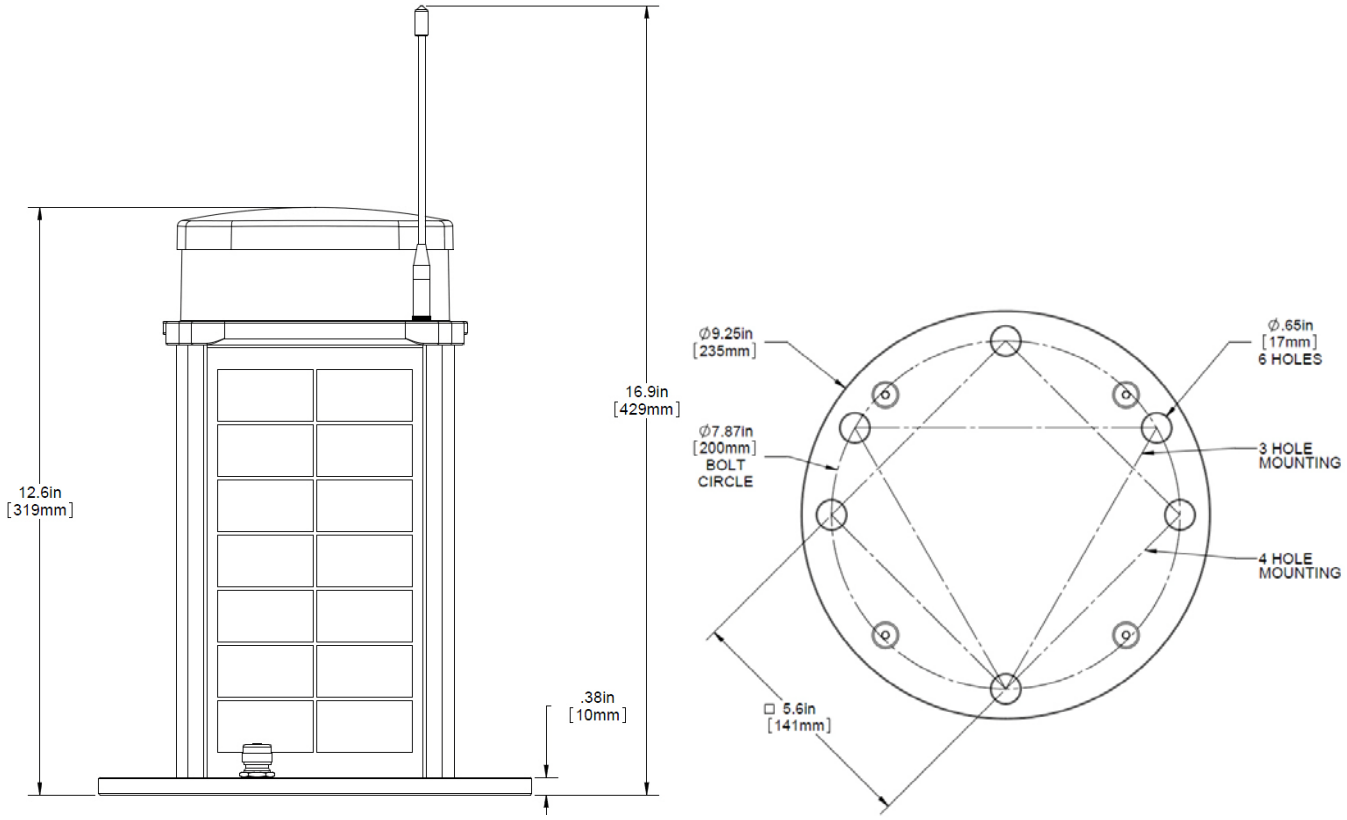
The handle can be used to orient the light relative to the runway. This is useful for directional and bidirectional lights:




### 2.3.4 Fastening

The SAWL-Hi can be mounted using 0.5 in. (12 mm) fasteners. The mounting holes have a bolt circle of 7.87 in. (200 mm). Fasteners are not included but are available as kits.







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## 2.4 Operation

### 2.4.1 Theory of Operation

During daylight, the solar panels charge the battery using the Energy Management System (EMS). The capacity of the battery ensures that even with poor levels of sunlight over an extended period, the light has enough reserve power to continue to perform reliably.

Stored battery energy is then available to power the output LEDs in one of several modes. These modes are selected using the push button user interface on the light or a Handheld Controller. The most commonly used modes are Autonomous and Temporary Modes.

The Handheld Controller contains a 900 MHz radio that transmits commands to a receiving radio inside the SAWL-Hi. For Handheld Controller operation and button sequences, see its manual.

### 2.4.2 User Interface

2.4.2.1 Indicator LEDs

Inside the lens, near the push button, are three indicator LEDs that illuminate green, amber or red. They:

- Guide push button operation
- Indicate diagnostic feedback
- Indicate normal operating state after the push button has not been used for 10 sec.:

| Indicator | Operating State |
|---|---|
| All indicators are off | Autonomous or Temporary Mode, Infrared LED output |
| | Storage Mode |
| Green indicator LED flashes 1x every 2 sec. | Autonomous or Temporary Mode, Visible LED output |
| Amber indicator LED flashes 1x every 1 sec. | Battery is charging via the external power connector |
| Amber indicator LED flashes 1x every 2 sec. | Battery is charging via the solar panels |



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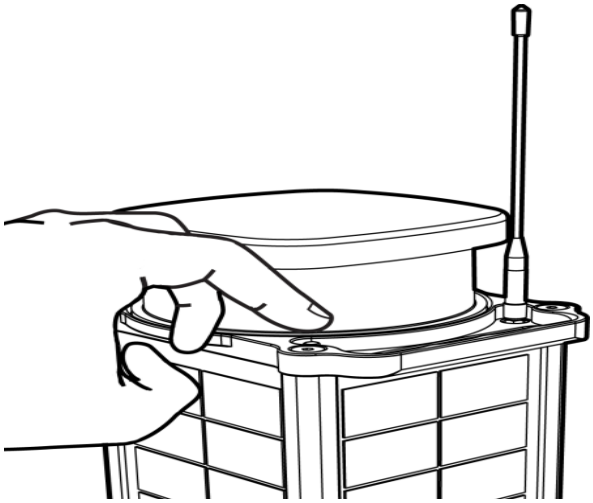
2.4.2.2 Push Button

The push button on the light is used for configuration and control.



It can be used in conjunction with, or instead of, a Handheld Controller for most modes and features.

The two types of push button inputs are:

| | |
|---|---|
| **Hold** | Pressing and holding the push button down for several sec. will cycle through the command levels |
| | The command level is indicated by the number of amber indicator LED flashes |
| | Once the desired command level has been reached, release the push button |
| **Press** | Momentarily pressing the push button 1x – 5x chooses a command within that command level |
| | Each momentary press must be quick and less than 1 sec. |
| | You must select a command within 10 sec. of entering a command level, otherwise the light exits that command level |
| | The green indicator LED flashes the number of accepted momentary presses |
| | The red indicator LED flashes three times if the command has not been accepted |

Indicator LED and push button sequences will be referred to as:

[**hold** push button for # amber indicator LED flashes, **press** push button #]

For example, [4,2] is:

1. Press and hold the push button until amber indicator LED flashes quickly 4x
2. Quickly press the push button 2x, green indicator LED flashes quickly 2x



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The following are all available push button commands:

| Step 1: Choose Command Level | | Step 2: Choose Command | | | | |
|---|---|---|---|---|---|---|
| **Action (Response)** | **Command Level** | **1 press (1 green flash)** | **2 presses (2 green flashes)** | **3 presses (3 green flashes)** | **4 presses (4 green flashes)** | **5 presses (5 green flashes)** |
| **No hold (0 amber flashes)** | **0** | Standby Mode [0,1] | Autonomous Low [0,2] | Autonomous Med [0,3] | Autonomous High [0,4] | Flash Toggle [0,5] |
| **2 sec. hold (1 amber flash)** | **1** | Temporary Low [1,1] | Temporary Med [1,2] | Temporary High [1,3] | No action | No action |
| **4 sec. hold (2 amber flashes)** | **2** | Storage Mode [2,1] | Do Not Use* | Do Not Use* | No action | No action |
| **6 sec. hold (3 amber flashes)** | **3** | Infrared Toggle [3,1] | No action | No action | No action | No action |
| **8 sec. hold (4 amber flashes)** | **4** | Battery Check [4,1] | UCS Status [4,2] | No action | No action | No action |
| **10 sec. hold (5 amber flashes)** | **5** | No action | Button Lock Toggle [5,2] | No action | No action | Factory Reset [5,5] |

* For engineering test purposes only. Use may result in unpredictable behavior of the light.



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## 2.4.3 Modes

2.4.3.1 Autonomous Mode

In Autonomous Mode, the output LEDs turn on during the night and turn off during the day. The change from day-to-night or night-to-day is known as a transition. A built-in ambient brightness sensor detects transitions.

**NOTE:** Autonomous Mode setting is determined by a map in the Appendices. Correct setting is important to ensure sustainable, year-round operation.

The Autonomous Mode setting is selected by push button sequence [0,2], [0,3], [0.4] or the Handheld Controller:

| Setting | Intensity | Output LEDs | Flashing | Active |
|---|---|---|---|---|
| Auto Low | Low | Visible | No | Dusk-to-dawn |
| AUTO MED | Medium | Visible | No | Dusk-to-dawn |
| AUTO HIGH | High | Visible | No | Dusk-to-dawn |
| Auto Low IR | Low | Infrared | No | Dusk-to-dawn |
| AUTO MED IR | Medium | Infrared | No | Dusk-to-dawn |
| AUTO HIGH IR | High | Infrared | No | Dusk-to-dawn |
| Auto Low flash | Low | Visible | 0.25 sec. on, 0.75 sec. off | Dusk-to-dawn |
| AUTO MED flash | Medium | Visible | 0.25 sec. on, 0.75 sec. off | Dusk-to-dawn |
| AUTO HIGH flash | High | Visible | 0.25 sec. on, 0.75 sec. off | Dusk-to-dawn |
| Auto Low IR flash | Low | Infrared | 0.25 sec. on, 0.75 sec. off | Dusk-to-dawn |
| AUTO MED IR flash | Medium | Infrared | 0.25 sec. on, 0.75 sec. off | Dusk-to-dawn |
| AUTO HIGH IR flash | High | Infrared | 0.25 sec. on, 0.75 sec. off | Dusk-to-dawn |

Factory default is AUTO LOW, visible LED, steady-on.

2.4.3.2 Temporary Mode

A Temporary Mode activation interrupts other modes and ignores transitions. This activation lasts for a preset time and then the light reverts to its previous Autonomous Mode.

**NOTE:** Maximum number of Temporary Mode activations per day is determined by a map in the Appendices.

The Temporary Mode setting is selected by push button sequence [1,1], [1,2], [1,3], or the Handheld Controller:

| Setting | Intensity | Output LEDs | Flashing | Activation, Handheld Controller command | Activation, push button command |
|---|---|---|---|---|---|
| temp Low | Low | Visible | No | 15 min. | 60 min. |
| TEMP MED | Medium | Visible | No | 15 min. | 60 min. |
| TEMP HIGH | High | Visible | No | 15 min. | 60 min. |
| temp Low IR | Low | Infrared | No | 15 min. | 60 min. |
| temp MED IR | Medium | Infrared | No | 15 min. | 60 min. |
| temp HIGH IR | High | Infrared | No | 15 min. | 60 min. |
| temp Low flash | Low | Visible | 0.25 sec. on, 0.75 sec. off | 15 min. | 60 min. |
| temp MED flash | Medium | Visible | 0.25 sec. on, 0.75 sec. off | 15 min. | 60 min. |
| temp HIGH flash | High | Visible | 0.25 sec. on, 0.75 sec. off | 15 min. | 60 min. |
| temp Low IR flash | Low | Infrared | 0.25 sec. on, 0.75 sec. off | 15 min. | 60 min. |
| temp MED IR flash | Medium | Infrared | 0.25 sec. on, 0.75 sec. off | 15 min. | 60 min. |
| temp HIGH IR flash | High | Infrared | 0.25 sec. on, 0.75 sec. off | 15 min. | 60 min. |




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2.4.3.3 Standby Mode

Standby Mode turns off the output LEDs and waits for the next day-to-night transition. After this transition, the light enters its previous Autonomous Mode.

Standby Mode is enabled by push button sequence [0,1] or the Handheld Controller.

2.4.3.4 Lights Off Mode

Lights Off Mode turns off the output LEDs indefinitely until it receives a command to turn them on.

Lights Off Mode is enabled by the Handheld Controller.

2.4.3.5 Emergency Mode

Emergency Mode sets all lights in all groups to emergency flash. Emergency flash is TEMP HIGH FLASH. After 15 min., the lights revert to their previous Autonomous modes.

Emergency Mode is enabled by the Handheld Controller.

2.4.3.6 ARCAL Mode

The Aircraft Radio Control of Aerodrome Lighting (ARCAL) feature works in conjunction with an ARCAL VHF receiver to allow aircraft pilots to control the airfield lights.

ARCAL Mode is enabled by the Handheld Controller.

2.4.3.7 Storage Mode

Storage Mode is a low power state used for storing or shipping the light. Lights are shipped from the factory in Storage Mode:

- No response to wireless control and not able to turn on its output LEDs
- Indicator LEDs are off
- Stores the last mode before entering Storage Mode
- Sunlight or external power will continue to charge the battery

**NOTE:** If the ambient light level is 30 lux or less for 24 hrs., the light will automatically enable Storage Mode

Storage Mode is enabled by push button sequence [2,1] or the Handheld Controller.

To disable Storage Mode, press the push button 1x.



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## 2.4.4 Features

2.4.4.1 Low Voltage Disconnect

Low Voltage Disconnect (LVD) protects the battery from being discharged to levels low enough to cause permanent damage. When LVD is entered:

- "Radio and output LEDs are disabled
- "Output LEDs flashes 0.1 sec. every 60 sec. to let the user know the light needs attention
- "Red indicator LED is flashing
- "Battery continues charging
- "When the battery state of charge reaches an acceptable level, LVD is exited.

LVD is enabled in all modes.

2.4.4.2 Automatic Light Control

Automatic Light Control (ALC) is a patented algorithm that matches the light's energy consumption to its energy storage. As the battery state of charge diminishes, ALC decreases the output LED intensity. ALC has 4 intensity steps until finally entering LVD. The ALC step depends on the battery state of charge. This ensures the light will continue to operate through periods of poor sunlight.

ALC is enabled in all Autonomous Modes.

ALC is disabled in all Temporary Modes.

2.4.4.3 Low Voltage Disconnect

Low Voltage Disconnect (LVD) protects the battery from being discharged to levels low enough to cause permanent damage. When LVD is entered:

- Radio and output LEDs are disabled
- Output LEDs flashes 0.1 sec. every 60 sec. to let the user know the light needs attention
- Red indicator LED is flashing
- Battery continues charging
- When the battery state of charge reaches an acceptable level, LVD is exited.

LVD is enabled in all modes.

2.4.4.4 External Power Operation

If continuous high intensity output or backup power is required, external power can be provided to the connector on the base plate:

Remove the connector cap and attach a power cable terminated with the correct mating connector and pinout:

- "MS3116 connector detailed in MIL-DTL-26482 (approved vendor: Amphenol PT06-E-8-3P-SR-025)
- "Connector accepts 24 - 20 AWG stranded wire
- "+9.0 to 13.5 VDC input @ 2.2 A max.

When connected, external power is used to power up the light and charge its battery.

External power is not a control signal and cannot configure the light. The push button or Handheld Controller is still used for normal operations.

- When external power is provided to the connector on the base plate, the light will not exit Temporary Mode after a preset time.

It will remain in Temporary Mode until commanded otherwise or until the light detects that external power is no longer available.




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2.4.4.5 Battery Check

Push button sequence [4,1] checks the battery state of charge. The indicator LEDs then show the following for 10 sec.:

| Indicator | Battery State of Charge |
|---|---|
| Green | Good, 75 - 100% |
| Amber | Charge, 50 - 75% |
| Red | LVD, 5 - 50% |
| Flashing Red | LVD, < 5% |

2.4.4.6 Flash Toggle

Push button sequence [0,5] toggles between steady-on and flashing output LEDs.

2.4.4.7 Infrared Toggle

Push button sequence [3,1] toggles between visible and infrared output LEDs.

2.4.4.8 Push Button Lock Toggle

- Push button sequence [5,2] toggles between locking and unlocking the push button:
- "Red indicator LED flashes 2x when the push button is first locked
- "When locked, push button commands are ignored
- "If any other push button command is given other than unlocking the push button, the red indicator LED flashes 3x
- "Green indicator LED flashes 2x when the push button is unlocked

2.4.4.9 Diagnose

The battery state of charge and radio health can be queried via the Handheld Controller using its Diagnose function.

Diagnose is disabled when LVD is entered.

2.4.4.10 Grouping

Grouping allows independent control of different subsets of lights on an airfield:

- There are 8 groups, numbered 1 through 8
- Each light can be assigned to only one group
- Handheld controller can control multiple groups at a time
- A light can be reassigned to another group as required
- When adding a light to a group, the Handheld Controller re-sends the last mode to everyone in that group

In order to configure the group of a light:

1. Light must be powered for at least 10 sec. and not in Storage Mode
2. Press the push button 1x. This instructs the light to receive grouping configurations from the Handheld Controller for 5 min.
3. Grouping configuration is sent from Handheld Controller
4. After successfully receiving a grouping configuration, the
5. light receives that group's last mode from the Handheld Controller.

Factory default is group 1.

2.4.4.11 Unique Code Sequence

Unique Code Sequence (UCS) allows one or more Handheld Controllers to be uniquely associated to one or more lights. When UCS is enabled, the Handheld Controller sends a code with each radio transmission. Only lights configured to accept that particular code will respond to the transmission. The benefits are:

| | |
|---|---|
| **Independence** | Nearby installations of lights can be operated independently by different Handheld Controllers without interference |
| **Security** | It is not possible for another Handheld Controller to interrupt airfield operation |

The Handheld Controller cannot control UCS configured and non-UCS configured lights at the same time.

For security, the user has to manually interact with the light for UCS configuration:

1. Light must be on for at least 10 sec. and not in Storage Mode
2. Press the push button 1x. This instructs the light to receive UCS configurations from the Handheld Controller for 5 min.



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3. UCS configuration is sent from Handheld Controller
4. After successfully receiving a UCS configuration, the light flashes for 5 sec.

Push button sequence [4,2] requests the UCS status from the indicator LEDs:

| Indicator | UCS |
|---|---|
| Amber | Enabled |
| Red | Disabled |

Factory default is UCS disabled.

2.4.4.12 Factory Reset

Push button sequence [5,5] performs a Factory Reset that sets the light back to a known state:

- AUTO LOW visible LED, steady-on
- Group 1
- UCS off

Green, amber, and red indicator LEDs momentarily turn on, then turn off once the reset is complete




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## 2.5 Maintenance

### 2.5.1 Inspection

Although the SAWL-Hi is maintenance-free, significant performance gains can be made with clean solar panels and lenses:

- Clean the solar panels monthly. Use water and a soft sponge or cloth. A mild non-abrasive cleanser can be used for more stubborn residue. Rinse well.
- Clean solar panels and lenses more frequently during drier months, as they may become covered in dust more quickly. A pressure washer is not recommended.
- Visual inspection – check the exterior for cracks, missing or broken hardware or other potential problems.

### 2.5.2 Storage & Battery Charging

When storing the light, it is important to maintain the battery:

- Put the light in Storage Mode or disconnect the battery
- Store in a cool location
- Check the battery state of charge every 1 month

**NOTE:** Do not use the Lights Off Mode for storing the light. The radio is still active in this mode and may receive wireless commands.

If charging is required, charge the battery fully using one of several methods:

| Source | Time to Charge from 10% to 100% State of Charge |
|---|---|
| Incandescent light bulb, 60 W<br>12 in. (30 cm) from solar panels | >1000 hrs. |
| Halogen light bulb, 500 W<br>24 in. (60 cm) from solar panels | 600 hrs. |
| Direct sunlight | 150 hrs. |
| Available AC plug-in charger attached to the connector on the base plate | 18 hrs. |



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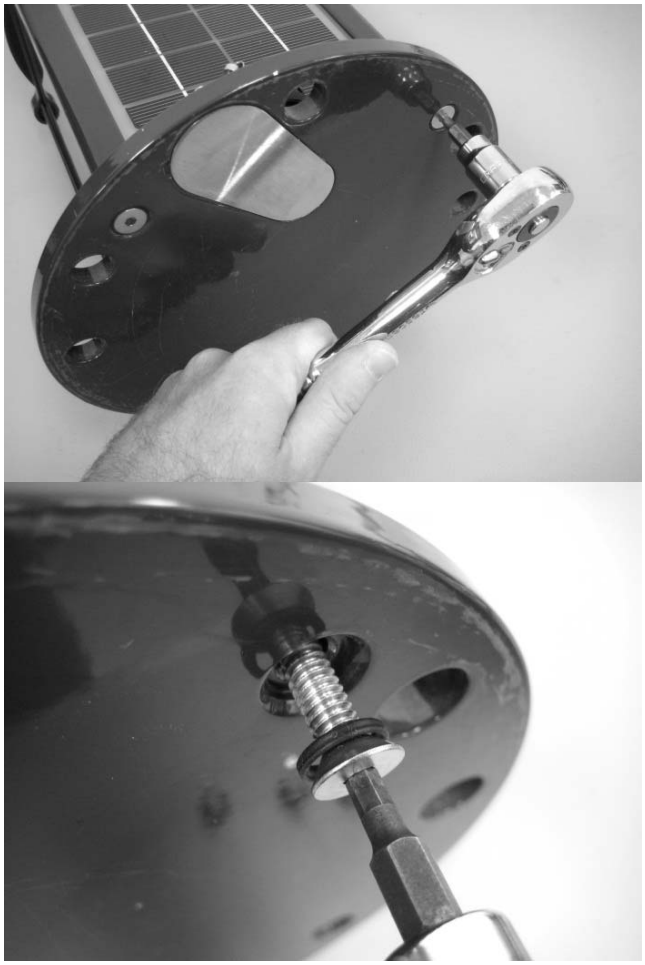
### 2.5.3 Battery Replacement

**NOTE:** The SAWL-Hi and the SAWL battery packs are not interchangeable. Contact your distributor for your specific replacement battery pack.

If the battery is permanently damaged and needs to be replaced:

1. Remove the 4 base plate screws using a 5/32 in. hex driver; be careful not to misplace their o-rings



2. Pull on the handle to slowly separate the chassis from the base plate

Use extreme caution with the metal chassis near the exposed battery terminals.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3. Disconnect the battery harness and remove the chassis



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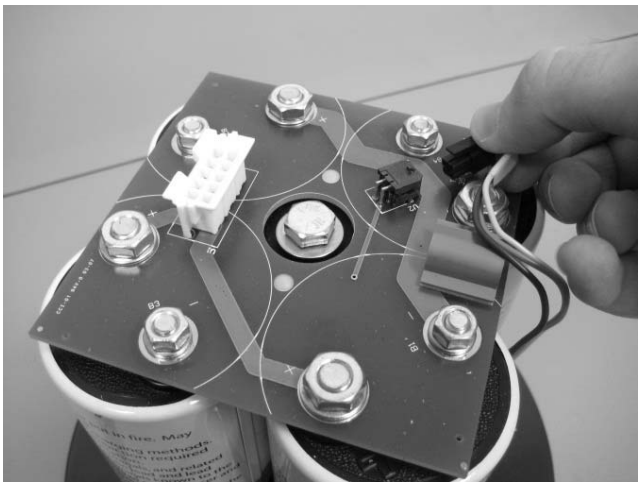
4. Disconnect the external power harness and remove from routing features





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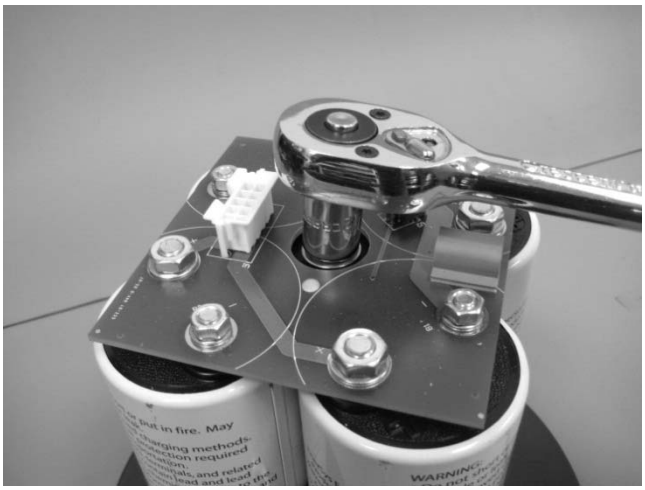
5. Using a ½ in. hex socket, remove only the central bolt and its hardware

Use extreme caution near the exposed battery terminals with metal tools. Remove all jewelry before attempting to handle or remove the batteries.



6. Pull the battery up and over its mounting post



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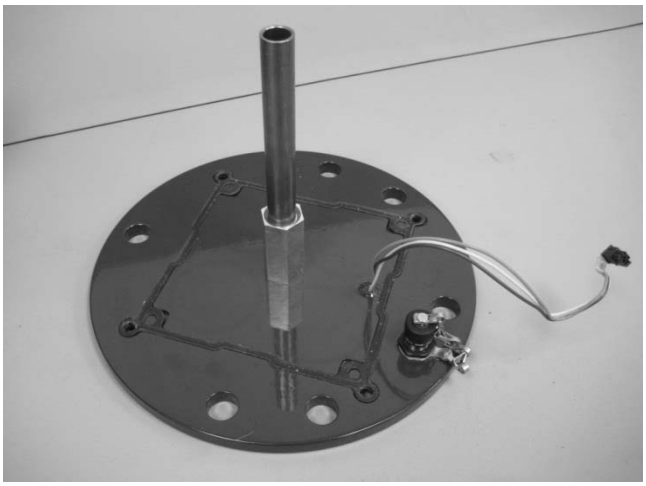



Installing a battery is similar to the above steps:

1. Carefully slide the battery over the mounting post, noting the correct orientation of the battery to the external power harness
2. Ensure the individual batteries are tight together and inside the base plate gasket. Tighten the central bolt and its hardware to 200 in.-lbs.
3. Connect the external power harness and attach it to its routing features
4. Ensure the base plate gasket is clean and seated in its groove
5. Hold the chassis over the battery and connect the battery harness
6. Align the handle with the connector on the base plate and slowly slide the chassis over the battery.

7. Press base plate screw o-rings into their counterbores. Tighten 4 base plate screws to 105 in.-lbs.


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### 2.5.4 Recycling

This product required the extraction and use of natural resources. It may contain substances that could be harmful to the environment or human health if improperly handled at the product's end of life. In order to avoid release of such substances into the environment and to reduce the use of natural resources, we encourage you to recycle the product in an appropriate way that will ensure most of the materials are reused or recycled appropriately. Check your local municipality for electronics recyclers.

**NOTE:** The symbol indicates that this product complies with the European Union's requirements according to Directive 2002/96/EC on waste electrical and electronic equipment (WEEE).

**NOTE:** The battery is a rechargeable lead-acid AGM battery. Consult your local laws for information on recycling.



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## 2.6 Troubleshooting

| Symptom | Feedback | Cause | Solution |
|---|---|---|---|
| Output LEDs are off<br>Unresponsive to wireless control | All indicator LEDs are off | Infrared output LEDs are on | De-select the IR button on the Handheld Controller and send a visible output command;<br>Use push button infrared toggle [3,1] |
| | | Storage Mode is active | De-activate Storage Mode by pressing push button 1x |
| | Output LEDs flash once every 60 sec;<br>Red indicator LED is flashing | LVD is entered | Charge the battery |
| Output LEDs are on or off<br>Unresponsive to wireless control | Green indicator LED is flashing; | Mismatched groups | Ensure the Handheld Controller's and light's group match |
| | | UCS is enabled | Ensure the Handheld Controller's and light's UCS match or turn off UCS |
| | | Antenna not installed | Ensure the light's antenna is properly installed |
| | | Handheld Controller problem | Check Handheld Controller battery, PIN status, and Passthrough |
| Output LEDs are off<br>Unresponsive to wireless control<br>Unresponsive to push button | All indicator LEDs are off | Battery is bad | Replace the battery |
| | | Battery is not connected | Check that the battery connector is fully inserted |
| Output LEDs are off in Autonomous Mode | All indicator LEDs are off | Infrared output LEDs are on | De-select the IR button on the Handheld Controller and send a visible output command;<br>Use push button infrared toggle [3,1] |
| | Green indicator LED is flashing | Daylight; ambient brightness is above 500 lux | Darken the entire light and wait 20 sec. for the light to turn on |
| | | Nearby lights are illuminating the ambient brightness sensor | Increase distance between lights, turn off unneeded lights, or shield lights |




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# 2.7 Appendices

## 2.7.1 Glossary

| | |
|---|---|
| AC | Alternating Current |
| ACGIH | American Conference of Governmental and Industrial Hygienists |
| AGM | Absorbed Glass Matt |
| ALC | Automatic Light Control |
| ARCAL | Aircraft Radio Control of Aerodrome Lighting |
| DC | Direct Current |
| EMS | Energy Management System |
| FAA | Federal Aviation Administration |
| FCC | Federal Communications Commission |
| ICAO | International Civil Aviation Organization |
| ICES | Industry Canada Equipment Standard |
| IR | Infrared |
| ISM | Industrial, Scientific and Medical |
| LED | Light Emitting Diode |
| LVD | Low Voltage Disconnect |
| NVG | Night Vision Goggle |
| OBUI | On-Board User Interface |
| RoHS | Restriction on Hazardous Substances |
| UCS | Universal Code Sequence |
| WEEE | Waste Electrical and Electronic Equipment |



## 2.7.2 Autonomous Mode

The recommended Autonomous Mode setting is determined by the amount of solar energy, day length, and ambient temperature at a given location. The below table and plot are based on:

- "Autonomous Mode operates dusk-to-dawn
- "No Temporary Mode activations
- "Worst Month of the year
- "Infrared output LEDs consume less energy than the visible output LEDs
- "Flashing consumes less energy since the LEDs are on for less time

Autonomy is the number of days that the light can operate without any solar energy. It is determined by the Autonomous Mode, day length, and the battery size. Several days of autonomy is required to ensure continued functionality during periods of poor weather.

| Autonomous Mode Settings | | | |
|---|---|---|---|
| **Blue Region** | **Yellow Region** | **Red Region** | **Grey Region** |
| AUTO LOW | AUTO MED | AUTO HIGH | Not recommended for installation |
| AUTO HIGH FLASH | AUTO HIGH FLASH | AUTO HIGH FLASH | |
| AUTO MED IR | AUTO HIGH IR | AUTO HIGH IR | |
| AUTO HIGH IR FLASH | AUTO HIGH IR FLASH | AUTO HIGH IR FLASH | |
| 14 days min. autonomy | 11 days min. autonomy | 8 days min. autonomy | |

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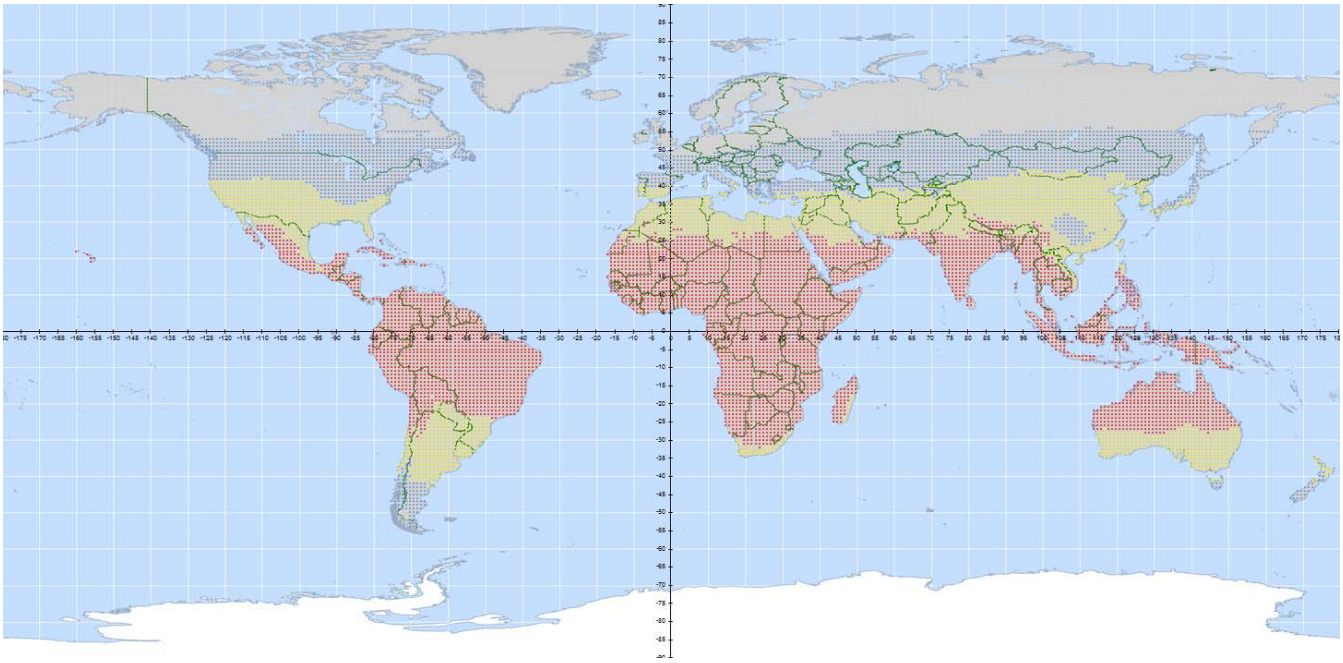
**Figure 1:**





### 2.7.3 Temporary Mode Activations

The maximum number of Temporary Mode activations per day is determined by the amount of solar energy and ambient temperature at a given location. The below table and plot are based on:

- "Handheld Controller commands with a 15 min. activation time
- "Light is in Lights Off Mode when not in a Temporary Mode activation
- "Worst month of the year
- "Infrared output LEDs consume less energy than the visible output LEDs
- "Flashing consumes less energy since the LEDs are on for less time

**NOTE:** It is possible to use more Temporary Mode activations per day. The battery will then require more than 1 day of solar energy to fully charge.

| | Temporary Mode Activations, daily max. | | | | |
|---|---|---|---|---|---|
| **Setting** | **Blue Region** | **Yellow Region** | **Red Region** | **Grey Region** | |
| temp Low | 4 | 13 | 22 | Not recommended for installation | |
| TEMP MED | 3 | 10 | 16 | | |
| TEMP HIGH | 2 | 6 | 10 | | |
| temp Low IR | 73 | 96 | 96 | | |
| temp MED IR | 43 | 96 | 96 | | |
| temp HIGH IR | 21 | 64 | 96 | | |
| temp Low flash | 16 | 49 | 81 | | |
| temp MED flash | 12 | 36 | 61 | | |
| temp HIGH flash | 8 | 23 | 39 | | |
| temp Low IR flash | 96 | 96 | 96 | | |
| temp MED IR flash | 96 | 96 | 96 | | |
| temp HIGH IR flash | 63 | 96 | 96 | | |

* 96 activations = 24 hrs. is the theoretical daily max.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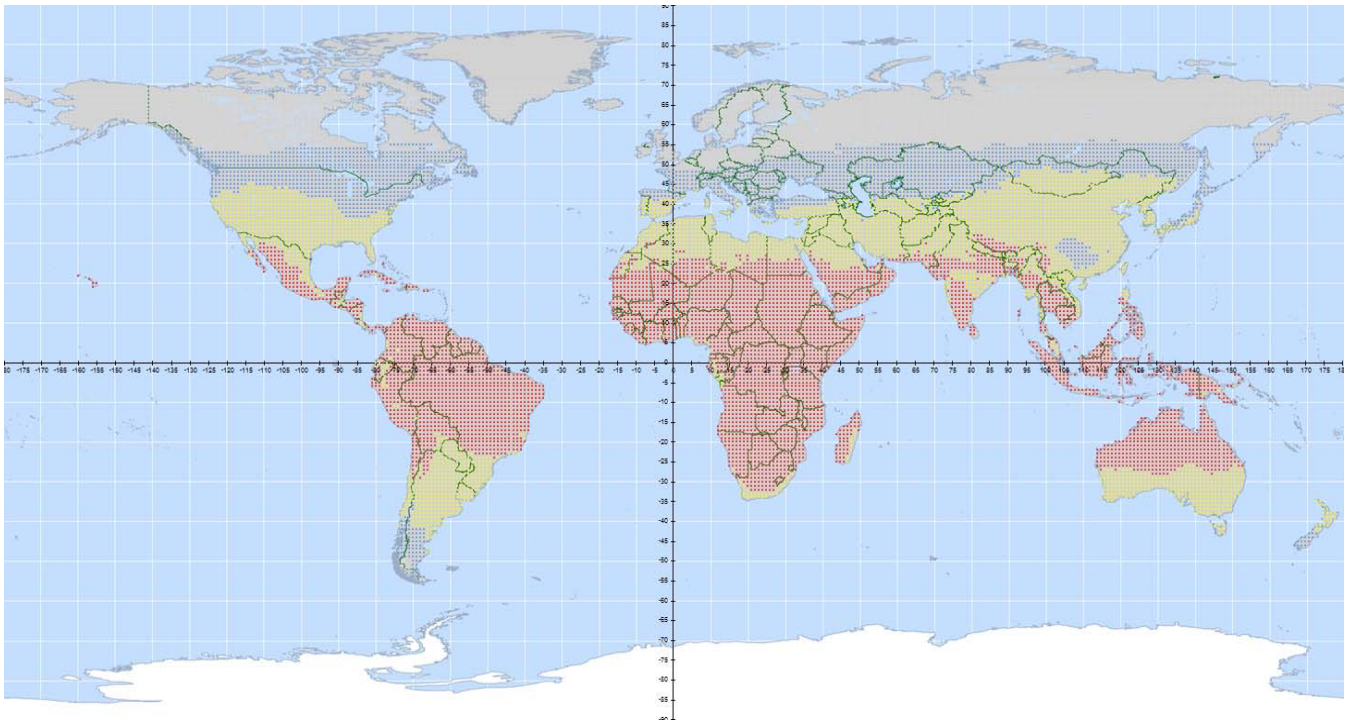



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### 2.7.4 Intensity

The minimum peak intensity for all modes and colors is below:

- "Visible output unit is candela (cd)
- "Infrared output unit is milliwatts per steradian (mW/sr) at 870 nm peak wavelength
- ""Directional" is a focused output beam
- ""Omnidirectional" is 360° output; when "Directional" is active, "Omnidirectional" is also active
- ""Bidirectional" is 180° output from one side of the light and 180° output from the other side
- ""Unidirectional" is 180° output only

| | | Peak Intensity, min. | | | | | |
|---|---|---|---|---|---|---|---|
| **Output** | **Direction** | **AUTO LOW or AUTO LOW FLASH** | **AUTO MED or AUTO MED FLASH** | **AUTO HIGH or AUTO HIGH FLASH** | **TEMP LOW or TEMP LOW FLASH** | **TEMP MED or TEMP MED FLASH** | **TEMP HIGH or TEMP HIGH FLASH** |
| **White** | **omnidirectional** | 18 | 45 | 74 | 160 | 160 | 160 |
| | **directional** | - | - | - | - | 248 | 504 |
| **Blue** | **omnidirectional** | 6 | 7 | 17 | 6 | 7 | 17 |
| **Red** | **omnidirectional** | 15 | 48 | 73 | 15 | 48 | 73 |
| **Yellow** | **omnidirectional** | 4* | 10* | 16* | 40* | 61* | 81* |
| **Green** | **omnidirectional** | 14 | 36 | 59 | 154 | 237 | 316 |
| **Red / Green** | **red directional** | 17 | 17 | 17 | 28 | 48 | 68 |
| | **green directional** | 44 | 109 | 179 | 320 | 415 | 557 |
| **Yellow / White** | **yellow bidirectional** | 13* | 32* | 52* | 112* | 112* | 112* |
| | **yellow directional** | - | - | - | - | 174* | 353* |
| | **white bidirectional** | 18 | 45 | 74 | 160 | 160 | 160 |
| | **white directional** | - | - | - | - | 248 | 504 |
| **Red / White** | **red bidirectional** | 9* | 23* | 37* | 80* | 80* | 80* |
| | **red directional** | - | - | - | - | 124* | 252* |
| | **white bidirectional** | 18 | 45 | 74 | 160 | 160 | 160 |
| | **white directional** | - | - | - | - | 248 | 504 |
| **Infrared** | **omnidirectional** | 14 | 31 | 74 | 14 | 31 | 74 |




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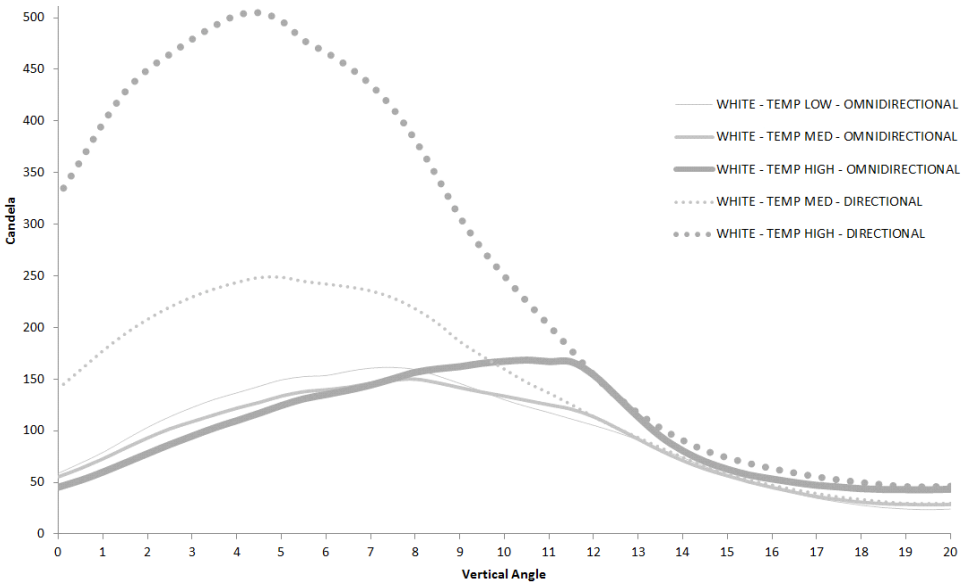
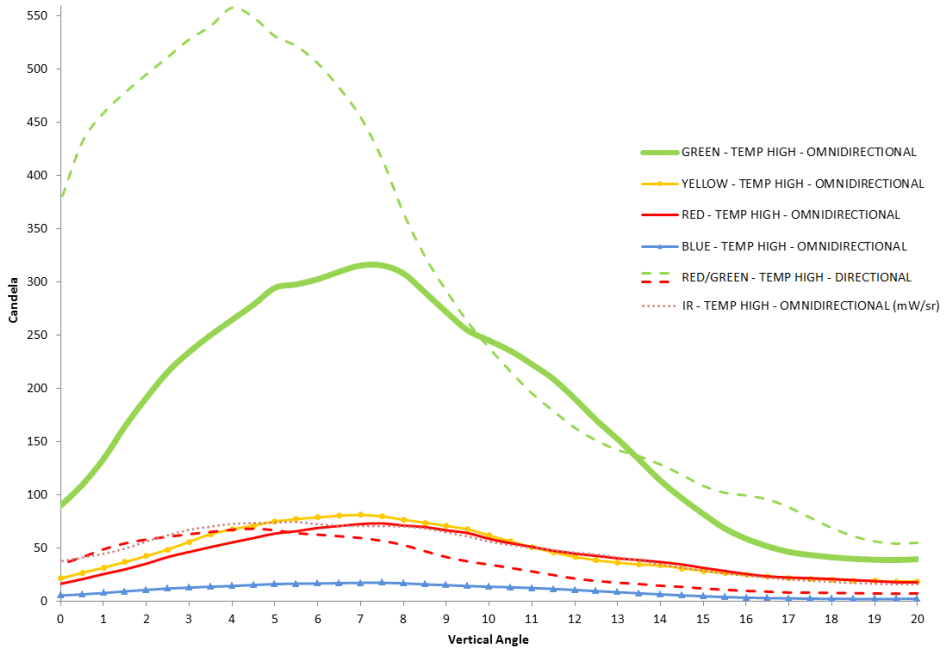
2.7.4.1 Preliminary values only

The minimum vertical divergence is plotted below for white at various settings:


Candela
Vertical Angle
WHITE - TEMP LOW - OMNIDIRECTIONAL
WHITE - TEMP MED - OMNIDIRECTIONAL
WHITE - TEMP HIGH - OMNIDIRECTIONAL
WHITE - TEMP MED - DIRECTIONAL
WHITE - TEMP HIGH - DIRECTIONAL

The vertical divergence is plotted below for various colors at TEMP HIGH:


Candela
Vertical Angle
GREEN - TEMP HIGH - OMNIDIRECTIONAL
YELLOW - TEMP HIGH - OMNIDIRECTIONAL
RED - TEMP HIGH - OMNIDIRECTIONAL
BLUE - TEMP HIGH - OMNIDIRECTIONAL
RED/GREEN - TEMP HIGH - DIRECTIONAL
IR - TEMP HIGH - OMNIDIRECTIONAL (mW/sr)

Detailed plot of the above:

Appendices

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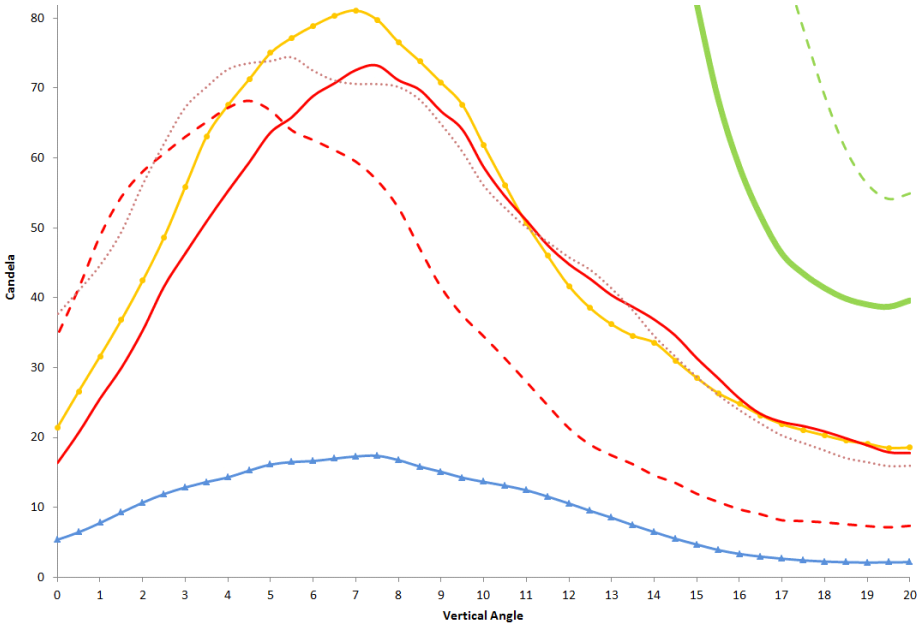
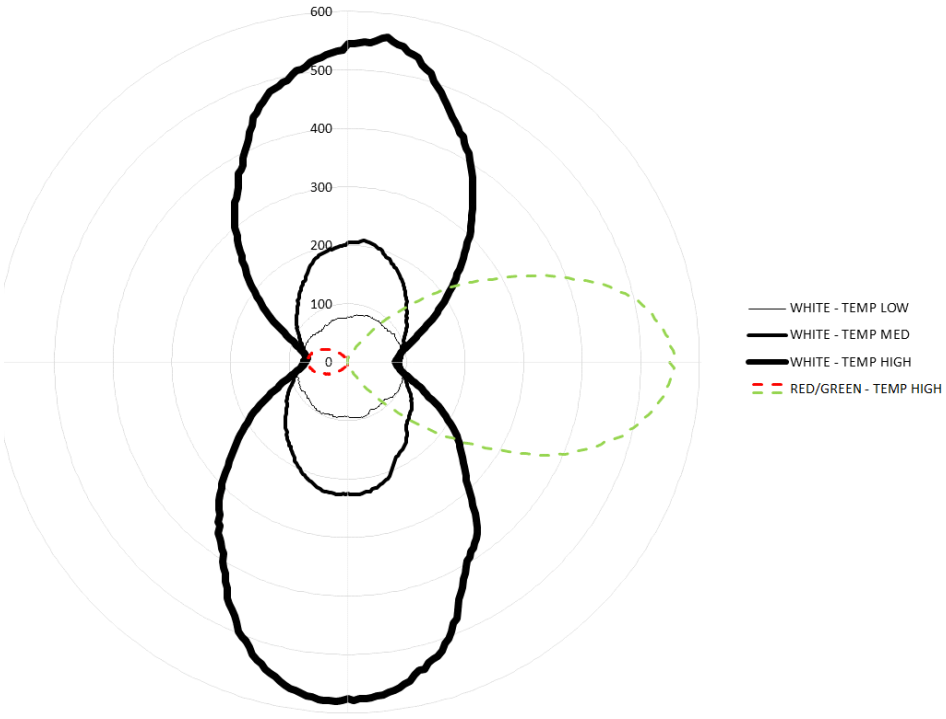



A representative horizontal intensity plot is below:




The light's handle is in the right-hand position on this plot and the units are cd. This shows that the red/green directional output is 90° to the white output with respect to the handle.

**NOTE:** White output changes from omnidirectional in AUTO LOW, AUTO MED, AUTO HIGH, and TEMP LOW settings to omnidirectional plus directional in the TEMP MED and TEMP HIGH settings.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The following are minimum recommended intensity settings to achieve a photometric specification. Higher intensity settings can be used, depending on the specification.

| | Photometric Specifications Met | | | | | |
|---|---|---|---|---|---|---|
| **Output** | **AUTO LOW** | **AUTO MED** | **AUTO HIGH** | **TEMP LOW** | **TEMP MED** | **TEMP HIGH** |
| **White** | | L-863W | | | | |
| | | L-860 | | | | |
| | | | ICAO runway 25 cd | ICAO runway 50 cd | | |
| | L-861 step 1 of 3 | L-861 step 2 of 3 | | L-861 step 3 of 3 | | |
| | | | | L-862 step 1 of 5 | L-862 step 2 of 5 | |
| **Blue** | L-863B | | | | | |
| | ICAO taxiway edge[1] | | | ICAO taxiway edge[1] | | |
| | L-861T[1] | | | L-861T[1] | | |
| **Red** | L-863R | | | | | |
| | ICAO Obs. Type A 10 cd | ICAO Obs. Type B 32 cd | | ICAO Obs. Type A 10 cd | ICAO Obs. Type B 32 cd | |
| | | | L-810 | | | L-810 |
| | L-860E | | | L-860E | | |
| **Yellow** | | | L-863Y* | | | |
| | | | | | | L-861* |
| **Green** | L-863G | | | | | |
| | | L-860E[2] | | | | |
| | | | ICAO heliport perimeter[1] | | | |
| | | | L-861[2] | | | |
| **Red / Green** | L-863R/G | | | | | |
| | L-861E step 1 of 3 | L-861E step 2 of 3 | | L-861E step 3 of 3 | | |
| | L-862E step 1 of 5 | | | | L-862E step 2 of 5 | |
| **Yellow / White** | | L-863W/Y* | | | | |
| | | | | | | L-861* |
| **Red / White** | | | | L-861* | | |
| **Infrared** | | | | | | |

* Preliminary values only

1 Compliant to 20° vertical; not measured from 20 to 90°

2 Unidirectional with available 180° shield kit

Detailed specifications for the above are:

- "ICAO Annex 14, 5th Ed. 2009
- "FAA AC 150/5340-30D
- "FAA AC 150/5345-46C
- "FAA AC 150/5345-43F
- "FAA AC 150/5345-50B
- "UFC 3-535-01



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## 2.8 Specifications

| | |
|---|---|
| **Physical** | |
| **Mounting** | 7.87 in. (200 mm) 3 or 4-hole bolting circle<br>0.5 in. (12 mm) hardware |
| **Chassis** | Powdercoated aluminum chassis, available in aviation yellow or olive drab<br>Polycarbonate lens<br>Waterproof, vented battery compartment |
| **Height** | 16.9 in. (429 mm) incl. antenna |
| **Width** | 7.8 in. (197 mm) incl. handle |
| **Weight** | 26 lb. (11.8 kg) |
| **Operating Temperature** | -22 to 122 °F (-30 to 50 °C) |
| **Storage Temperature** | -40 to 176 °F (-40 to 80 °C) |
| **Optical** | |
| **Light Source** | High-power visible LEDs<br>Infrared LEDs, NVG-compatible |
| **Intensity** | See plots in Appendices |
| **Chromaticity** | Visible:ICAO and FAA (SAE 25050) blue, red, white, yellow, and red<br>Infrared:870 – 890 nm peak wavelength |
| **Flash Pattern** | 0.25 sec. on, 0.75 sec. off |
| **Ambient Light Sensing** | 445 – 505 lux |
| **Automatic Light Control (ALC)** | Yes, ALC will reduce output intensity in response to unusually low amounts of sunlight to ensure continued operation |
| **Color Indicator** | Yes |
| **Energy Collection** | |
| **Control** | Intelligent, microprocessor Energy Management System (EMS) |
| **Solar Panel** | High-efficiency cells<br>Blocking diode function |
| **Air Gap between Solar Panel and Sunlight** | No, an air gap is undesirable because it refracts sunlight and decreases the amount of solar energy collected |
| **Battery Charger** | Maximum Power Point Tracking (MPPT) collects the most energy under all sunlight conditions<br>Temperature-compensated<br>Reverse polarity protection |
| **Battery** | Pure lead, valve-regulated lead-acid (VRLA)<br>Absorbed glass mat (AGM) w/ metal case<br>Recyclable |
| **Battery Charge Connector** | Yes |
| **External Power Operation** | Yes, able to operate long-term using cabled, external power<br>+9.0 to 13.5 VDC input @ 2.2 A max. |
| **User Interface** | |
| **User Interface** | Yes, push button and indicator LEDs |
| **Datalogger** | Yes |
| **Battery State of Charge** | Yes |




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| | |
|---|---|
| **Wireless Control** | |
| **Radio** | 902 – 928 MHz FHSS<br>Up to 2.5 miles (4 km) range<br>Replaceable antenna |
| **Light Control** | Visible, infrared, steady-on, and flashing settings<br>Autonomous, Temporary, Standby, Lights Off, and Emergency Modes |
| **Diagnostics** | Yes |
| **Grouping** | Yes, up to 8 |
| **Universal Code Sequence (UCS)** | Yes |
| **ARCAL Control** | Yes |
| **Standards and Testing** | |
| **ICAO Photometrics** | See tables in Appendices |
| **FAA Photometrics** | See tables in Appendices |
| **Vibration** | MIL-STD-202G, Method 204, Test Condition B, 5 G peak |
| **Shock** | MIL-STD-202G, Method 213B, Test Condition G |
| **Wind Loading** | 400 mph (179 m/s) |
| **Ingress** | EN 60529, IP 67<br>MIL-STD-202G, Method 104A, Test Condition B |
| **Electrostatic Discharge (ESD)** | EN 61000-4-2up to ± 8 kV air and ± 4 kV contact discharge<br>FAA-STD-019Ecompliant for ESD |
| **Electromagnetic Interference (EMI) & Electromagnetic Compatibility (EMC)** | FCC Part 15emissions & immunity<br>ICES-003emissions & immunity<br>EN 61000-6-3emissions<br>EN 61000-6-2immunity |
| **LED Lumen Maintenance** | IES LM-80 |
| **Battery Life** | IEC 61427 |
| **Humidity / Damp Heat** | MIL-STD-202G, Method 103B, Test Condition B |
| **RoHS** | Yes |
| **Patents** | US 5 782 552, 6 013 985, 6 573 659 and other US and international patents apply |



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**SAWL-High Intensity Solar Light**
**User's Manual**


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